Impact of Sediment Temperature Gauge Used to Estimate Stream Seepage

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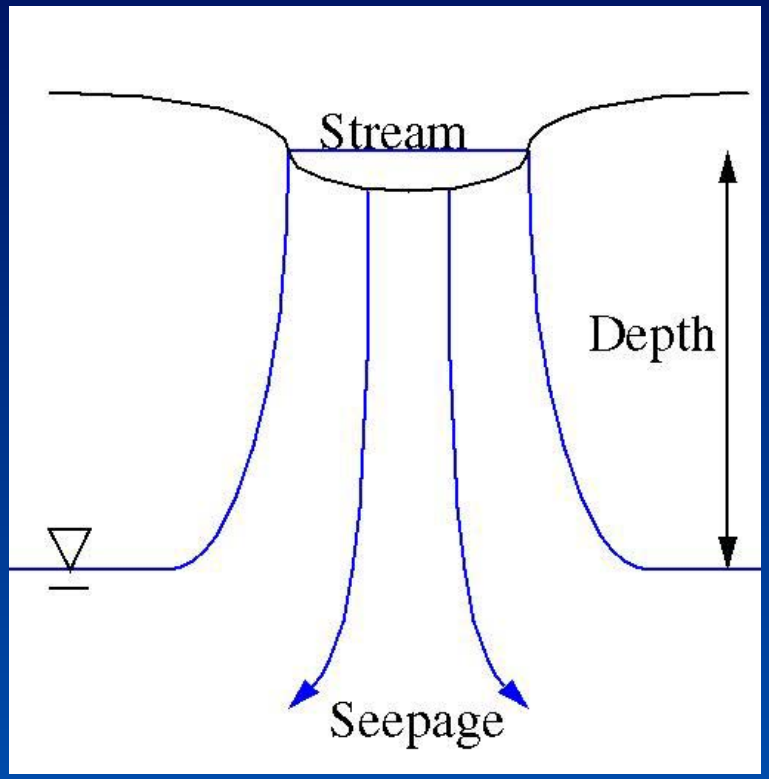
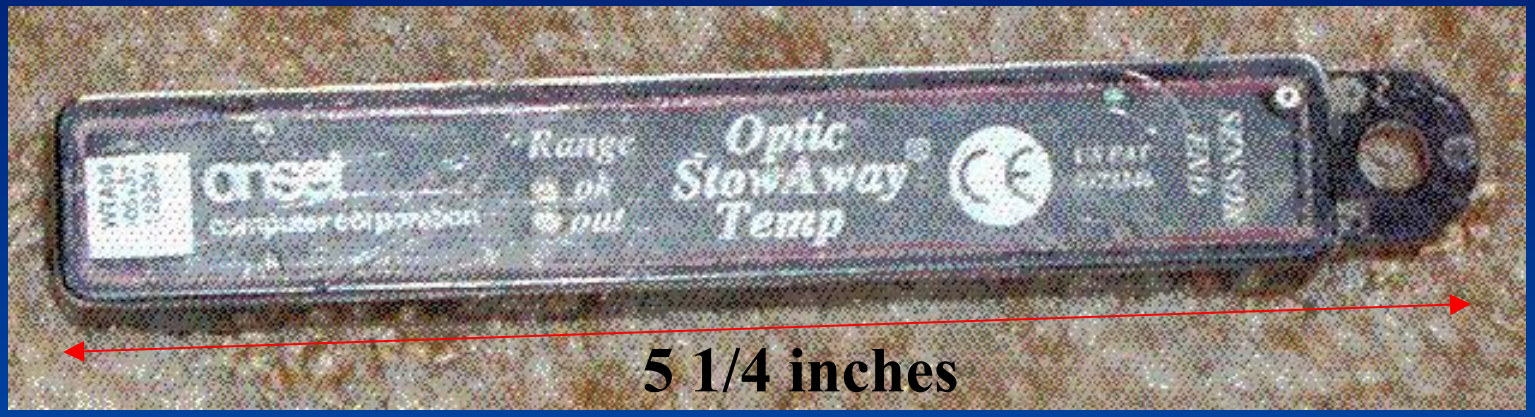
Monitoring Technique



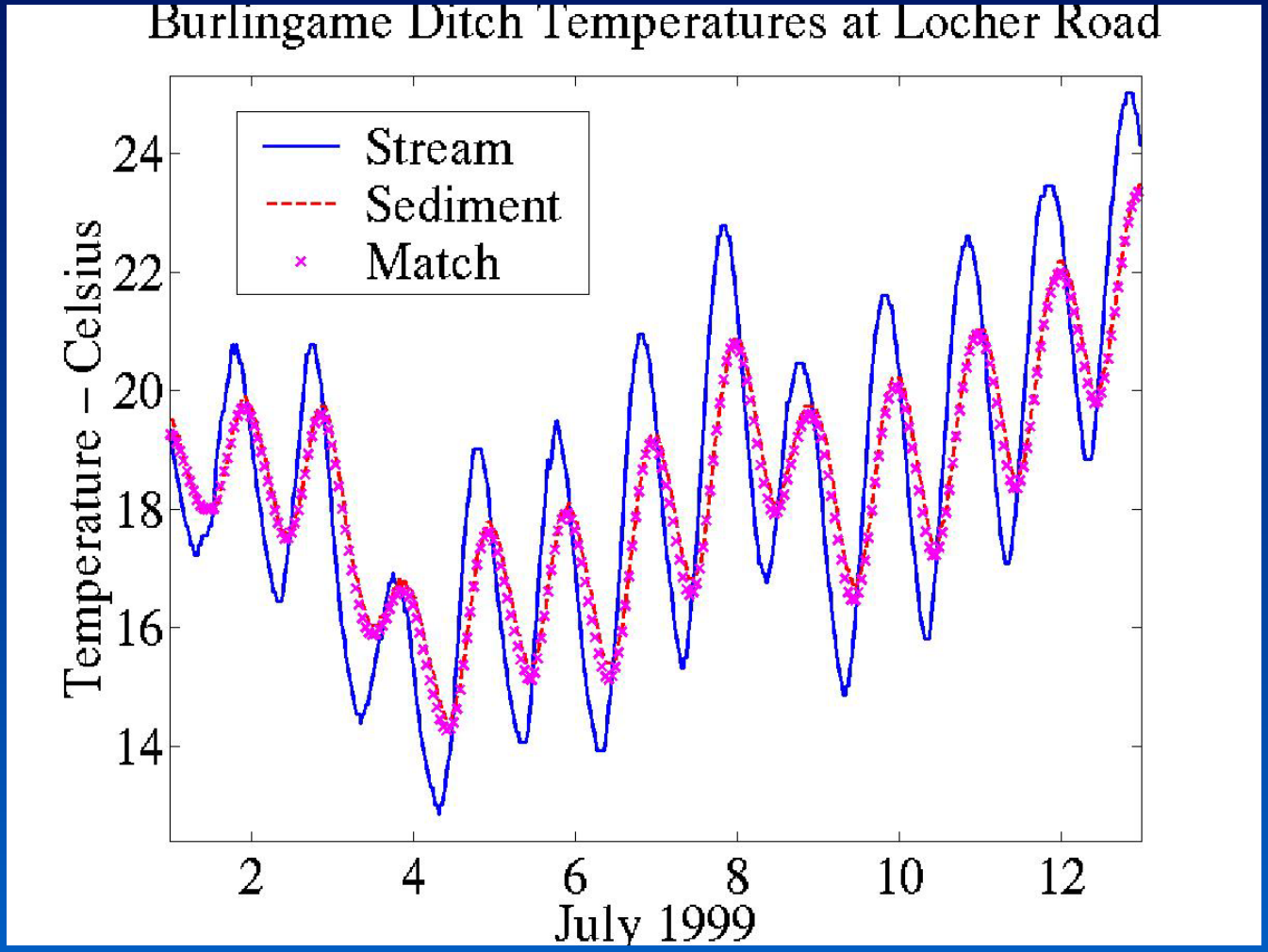
- ***Measure stream and sediment temperatures over time.***
- ***Change in sediment temperature estimates seepage.***

The Equipment: Continuous Temperature Gage



- *Measures continuously until removed*
- *Must be removed to download temperature data*

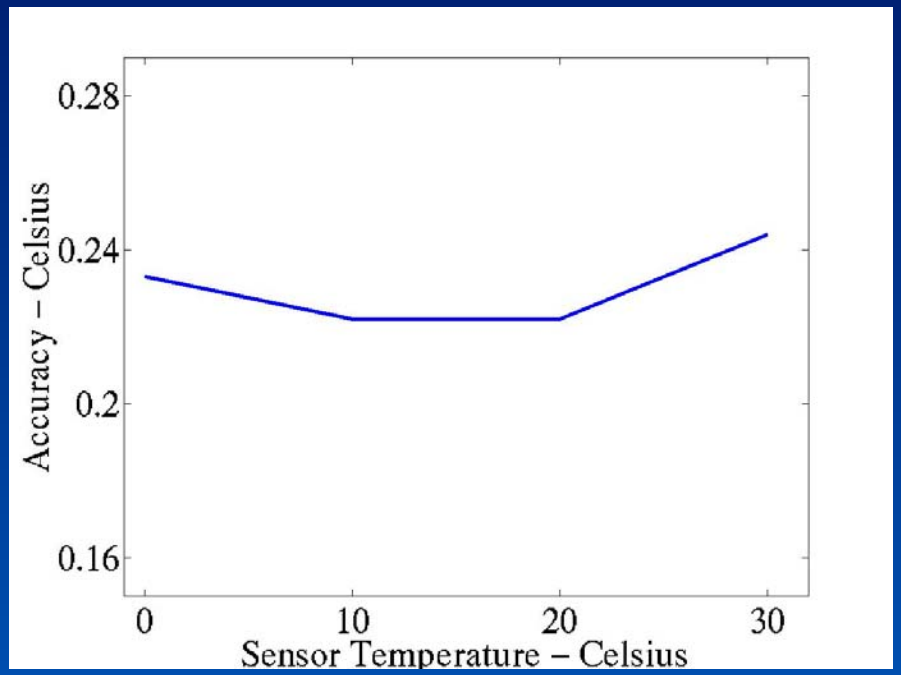
Resulting Temperatures



The Problems

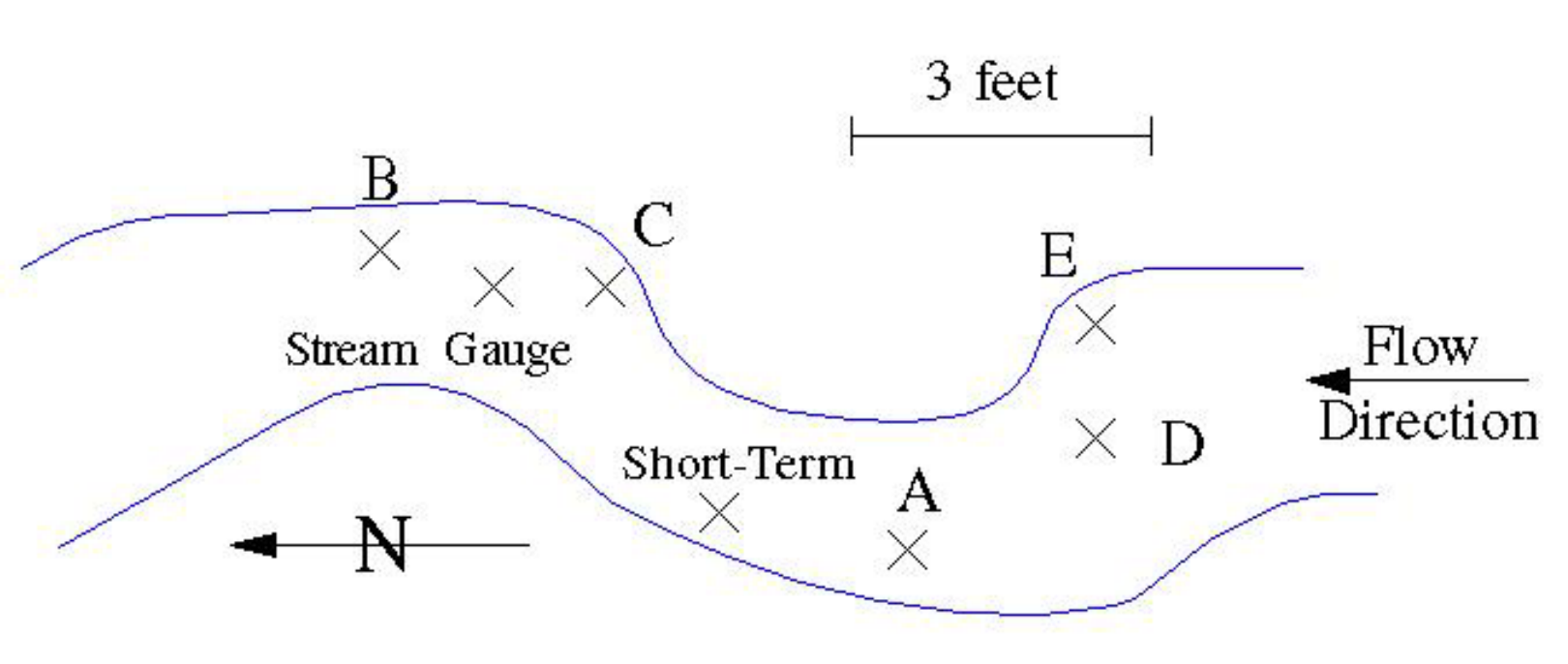
- *Calibration error*
- *Impact on seepage estimate*
- *Auger needed for dense sediments*

Manufacturer Consideration: Calibration



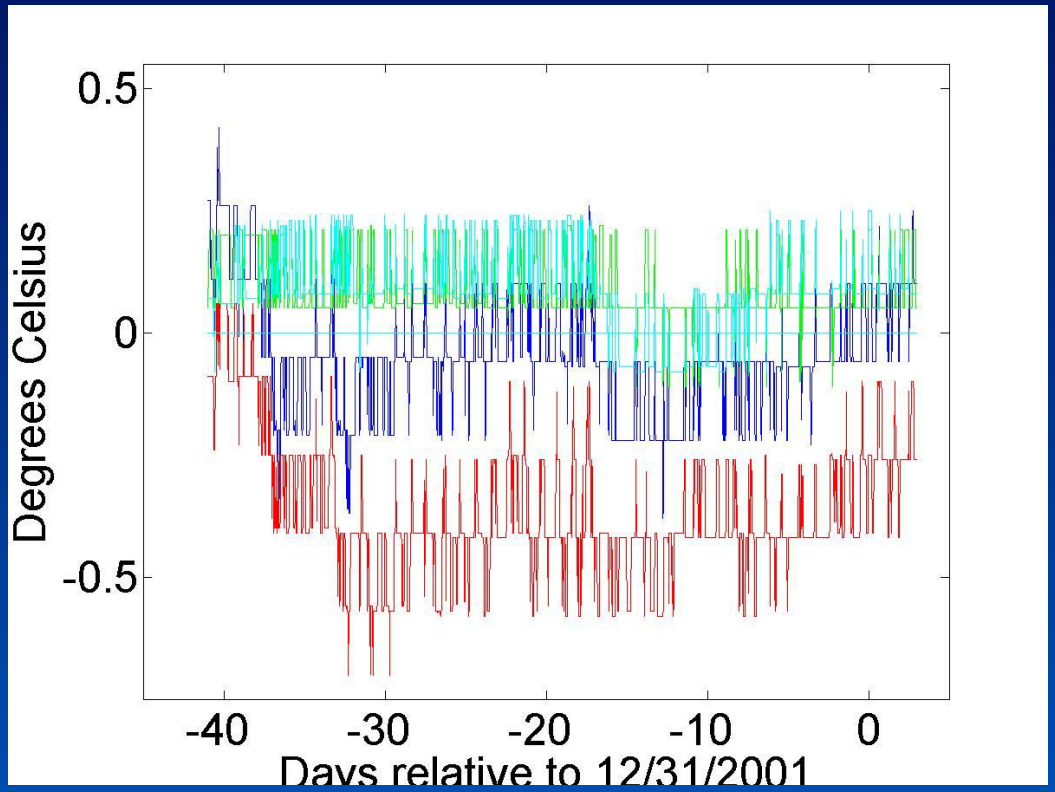
- *Calibration error is less than a ¼ degree Celsius*

Spangle Creek



- *Location 15 miles south of Spokane*
- *Flow between 0.1 and 100 cubic feet per second*
- *Loessal sediments with stream slope 0.005*

Redundant Temperature Gauges



- *Average difference between –0.4 and +0.1*
- *Differences due to calibration or location?*

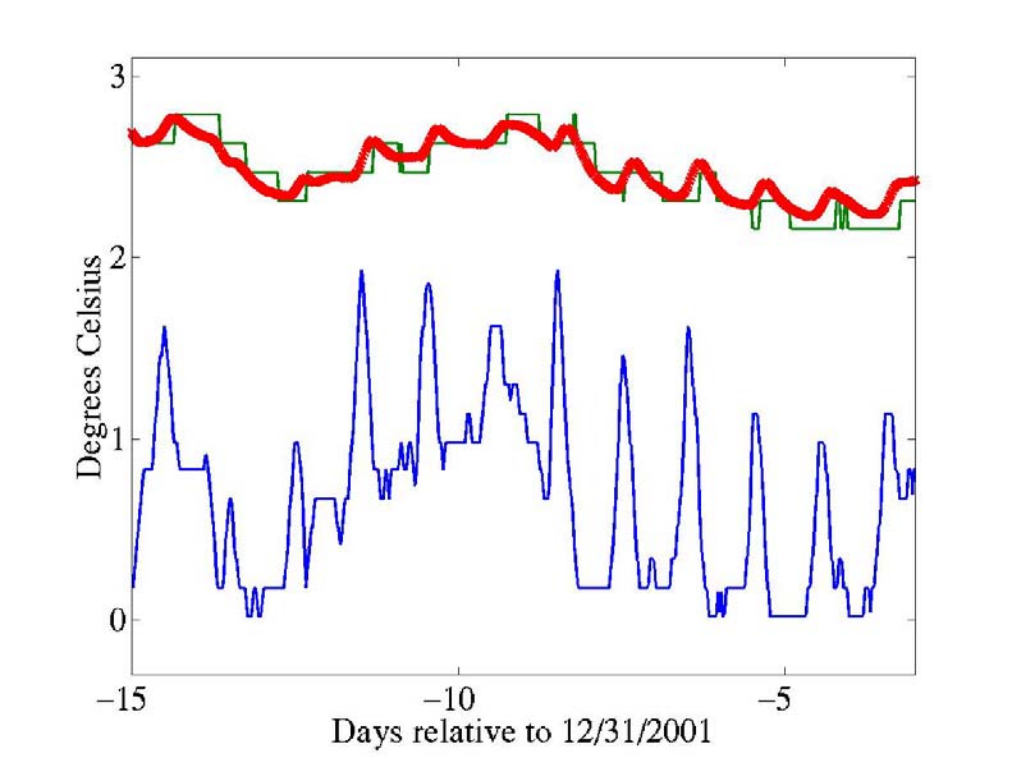
The Math: Governing Equation

$$D_T \frac{\partial^2 T}{\partial z^2} - \chi q_w \frac{\partial T}{\partial z} = \frac{\partial T}{\partial t}$$

Conduction Convection Storage

- *One-dimensional heat transfer model*
- *Assumes homogeneous soil conditions*
- *Requires estimates for thermal properties for soil*

Variation of Seepage Estimates

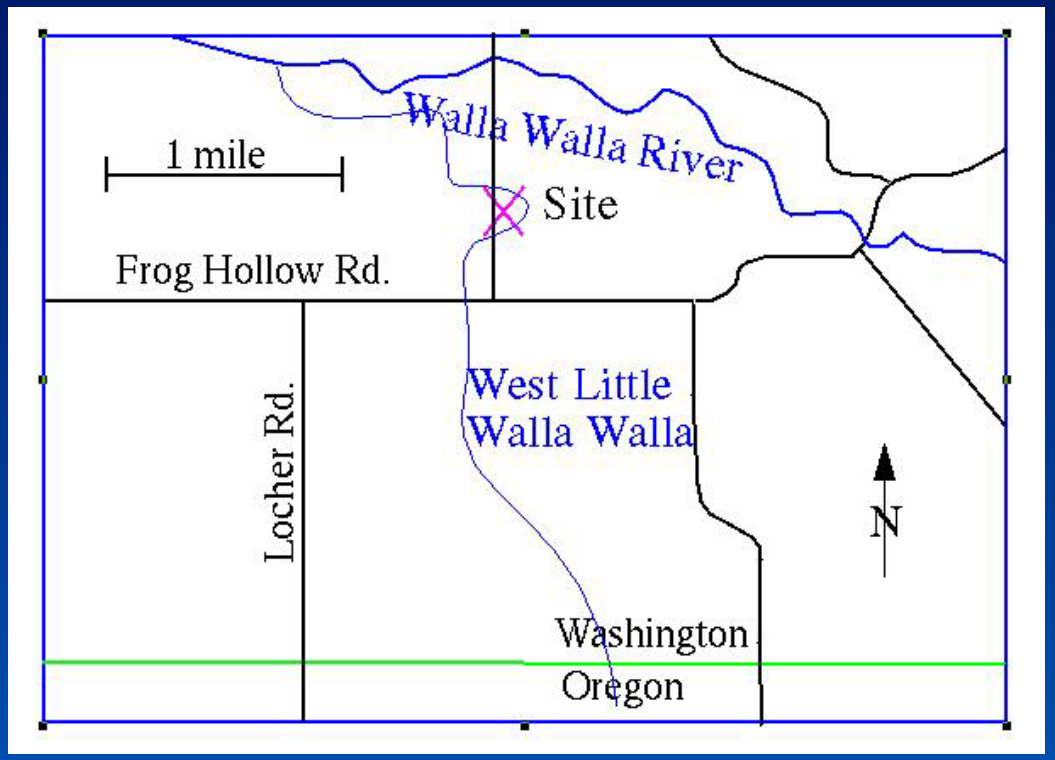


- *High temperature: 8 feet/day – low: 5 feet/day*
- *Not significantly different given parameter uncertainty*

Installation Difficulty

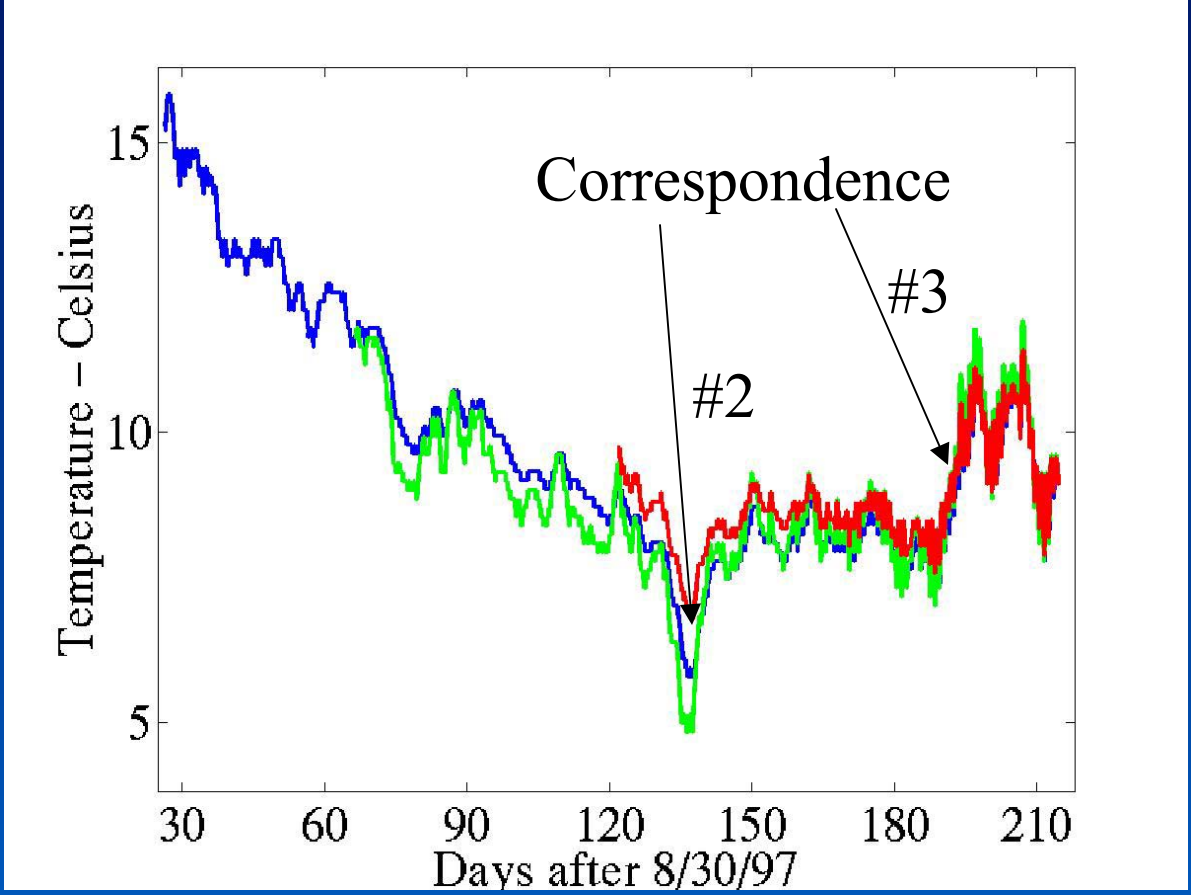
- *Plastic gauge cannot be inserted by itself*
- *How does 1” auger impact flow and temperatures?*

West Prong of the Little Walla Walla



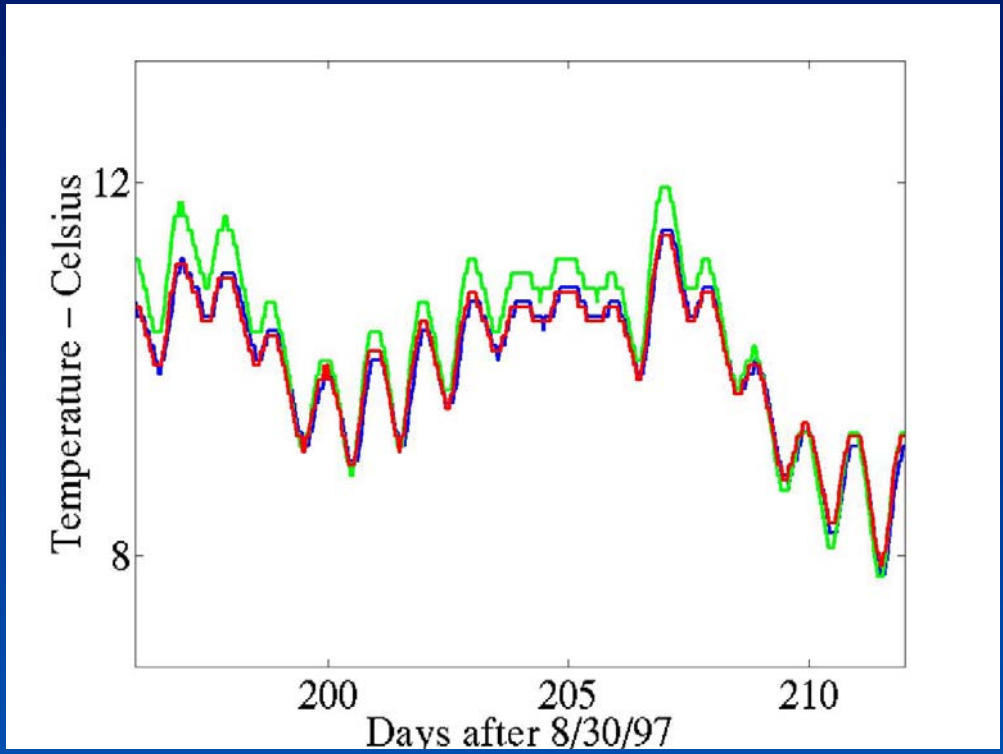
- *Regulated flows between 0 and 5 cubic feet per second*
- *Highly varied sediments, from loess to clayey gravel*

Correspondence of Temperatures



- ***Gauge 2 after 62 days, Gauge 3 after 72 days***

Temperature Detail



- *Gauge 2 (Green) may be shallower than others*
- *Change in overlying sediment was significant*

Conclusions

- ***Sediment temperature variation not just calibration***
- ***Calibration error within order-of-magnitude estimate***
- ***Auger requires 2 1/2 months for valid measurement***
- ***Changes in sediment cause errors in seepage estimate***